U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB80-100449

# Fine Particle Emissions Information System

Midwest Research Inst, Kansas City, MO

Prepared for

Industrial Environmental Research Lab, Research Triangle Park, NC

May 79

United States
Environmental Protection
Agency

Industrial Environmental Research
Laboratory
Research Triangle Park NC 27711

EPA-600/7-79-126
May 1979

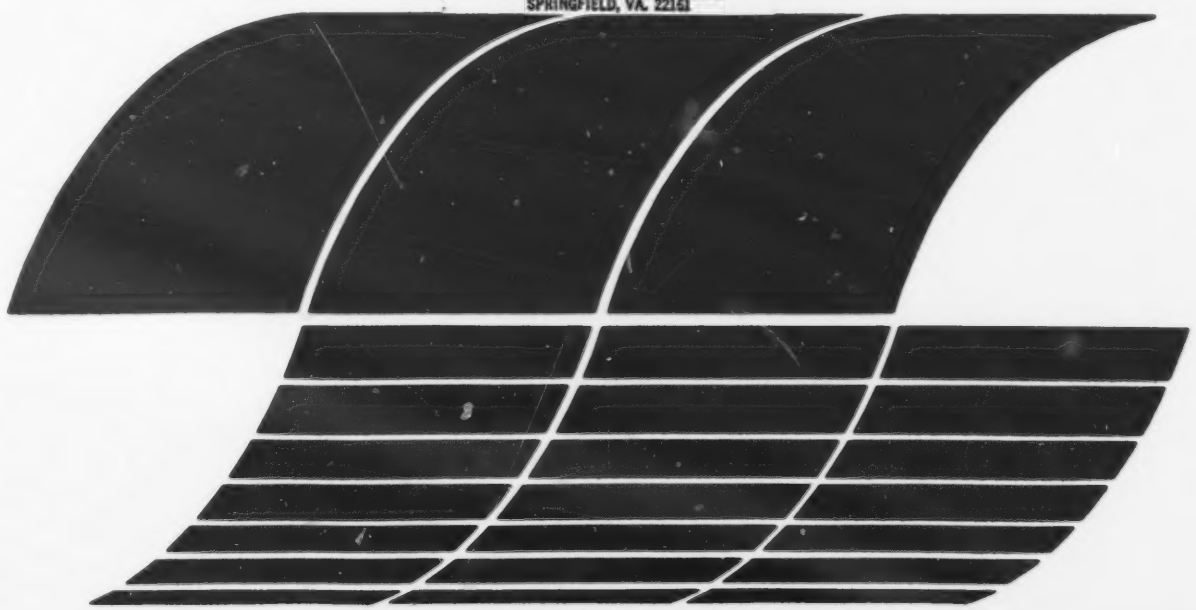
PB80-100449

EPA

# Fine Particle Emissions Information System: Annual Report (1978)

## Interagency Energy/Environment R&D Program Report

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161



## RESEARCH REPORTING SERIES

Research reports of the Office of Research and Development, U.S. Environmental Protection Agency, have been grouped into nine series. These nine broad categories were established to facilitate further development and application of environmental technology. Elimination of traditional grouping was consciously planned to foster technology transfer and a maximum interface in related fields. The nine series are:

1. Environmental Health Effects Research
2. Environmental Protection Technology
3. Ecological Research
4. Environmental Monitoring
5. Socioeconomic Environmental Studies
6. Scientific and Technical Assessment Reports (STAR)
7. Interagency Energy-Environment Research and Development
8. "Special" Reports
9. Miscellaneous Reports

This report has been assigned to the INTERAGENCY ENERGY-ENVIRONMENT RESEARCH AND DEVELOPMENT series. Reports in this series result from the effort funded under the 17-agency Federal Energy/Environment Research and Development Program. These studies relate to EPA's mission to protect the public health and welfare from adverse effects of pollutants associated with energy systems. The goal of the Program is to assure the rapid development of domestic energy supplies in an environmentally-compatible manner by providing the necessary environmental data and control technology. Investigations include analyses of the transport of energy-related pollutants and their health and ecological effects; assessments of, and development of, control technologies for energy systems; and integrated assessments of a wide range of energy-related environmental issues.

## EPA REVIEW NOTICE

This report has been reviewed by the participating Federal Agencies, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Government, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

**TECHNICAL REPORT DATA**
*(Please read Instructions on the reverse before completing)*

| | |
|---|---|
| 1. REPORT NO. EPA-600/7-79-126 | 2. |
| 3. RECIPIENT'S ACCESSION NO. | |
| 4. TITLE AND SUBTITLE: Fine Particle Emissions Information System: Annual Report (1978) | 5. REPORT DATE: May 1979 |
| | 6. PERFORMING ORGANIZATION CODE |
| 7. AUTHOR(S): M. P. Schrag, J. P. Reider, and F. N. Young (MRI Systems Corporation) | 8. PERFORMING ORGANIZATION REPORT NO. |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS: Midwest Research Institute, 425 Volker Boulevard, Kansas City, Missouri 64110 | 10. PROGRAM ELEMENT NO. EHE624A |
| | 11. CONTRACT/GRANT NO. 68-02-2641 |
| 12. SPONSORING AGENCY NAME AND ADDRESS: EPA, Office of Research and Development, Industrial Environmental Research Laboratory, Research Triangle Park, NC 27711 | 13. TYPE OF REPORT AND PERIOD COVERED: Annual; 1-12/78 |
| | 14. SPONSORING AGENCY CODE: EPA/600/13 |

15. SUPPLEMENTARY NOTES: IERL-RTP project officer is Gary L. Johnson, Mail Drop 63, 919/541-2745.

16. ABSTRACT: The report is the first annual report on the Fine Particle Emissions Information Systems (FPEIS), a computerized data base on primary fine particle emissions from stationary sources. The reportsummarizes changes made in 1978, including the expanded reporting of chemical analysis data, the entering of confidential or proprietary data, and the development of computer software to aid users in interpreting the FPEIS data. It lists new data added to the FPEIS in 1978 and outlines objectives for 1979, including the addition of biological and radiological analysis results and the implementation of a new source categorization protocol. The FPEIS provides a centralized inventory of fine particle measurement information for researchers engaged in fine particle control technology development and in the environmental assessment of energy and industrial processes. From an initial data loading for about 50 test sites in January 1977, the FPEIS program had grown to 120 test sites and almost 2000 sampling runs by the end of December 1978.

17. KEY WORDS AND DOCUMENT ANALYSIS

| a. DESCRIPTORS | b. IDENTIFIERS/OPEN ENDED TERMS | c. COSATI Field/Group |
|---|---|---|
| Pollution | Pollution Control | 13B |
| Dust | Stationary Sources | 11G 09B |
| Emission | Particulate | 14B 06A |
| Assessments | Fine Particle Emissions Information System | 06E 13H |
| Industrial Processes | Environmental Assessment | 10A 07D |
| Energy Conversion Techniques | | |
| Chemical Analysis | | |
| Computer Systems Programs | | |
| Bioassay | | |
| Radiology | | |

| | | |
|---|---|---|
| 18. DISTRIBUTION STATEMENT: Unlimited | 19. SECURITY CLASS (This Report): Unclassified | 21. NO. OF PAGES: 53 |
| | 20. SECURITY CLASS (This page): Unclassified | 22. PRICE: PC A04/MF A01 |

EPA Form 2220-1 (9-73)

EPA-600/7-79-126

May 1979

# Fine Particle Emissions Information System: Annual Report (1978)

by

M. P. Schrag (MRI), J. P. Reider (MRI),
and F. N. Young (MRI Systems Corporation)

Midwest Research Institute
425 Volker Boulevard
Kansas City, Missouri 64110

Contract No. 68-02-2641
Program Element No. EHE624A

EPA Project Officer: Gary L. Johnson

Industrial Environmental Research Laboratory
Office of Energy, Minerals, and Industry
Research Triangle Park, NC 27711

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

## PREFACE

This report was prepared for the Environmental Protection Agency Industrial Environmental Research Laboratory in Research Triangle Park, North Carolina under Contract No. 68-02-2641, MRI Project No. 4396-L. The Environmental Protection Agency project officer was Mr. Gary L. Johnson.

The work was performed in the Environmental and Materials Sciences Division at Midwest Research Institute. Mr. M. P. Schrag, Deputy Director of the Division, served as program manager, and Mr. J. Patrick Reider, Associate Environmental Engineer, served as project leader.

The report was written by Mr. Schrag and Mr. Reider of Midwest Research Institute; and Mr. F. N. Young of MRI Systems, Inc. The authors appreciate the contributions made to the program and to this report by Dr. R. F. Hegarty, Associate Engineer, and Mr. Gary L. Johnson, the EPA Project Officer. Mr. T. Sutikno, Assistant Engineer, contributed significantly to this program.

Approved for:

MIDWEST RESEARCH INSTITUTE

M. P. Schrag, Deputy Director
Environmental and Materials
Sciences Division

CONTENTS


| | Page |
|---|---|
| Preface | iii |
| Figures | vi |
| Tables | vii |
| 1. Introduction | 1 |
| 1.1 Origin of the FPEIS | 1 |
| 1.2 Structure of the FPEIS | 2 |
| 1.3 FPEIS organization | 3 |
| 1.4 FPEIS technology transfer | 3 |
| 1.5 FPEIS annual report | 7 |
| 2. Data Base Modifications | 8 |
| 2.1 FPEIS modifications | 8 |
| 2.2 FPEIS documentation update | 9 |
| 3. Data Additions | 13 |
| 4. FPEIS Data Base: State-of-the-Art Summary | 17 |
| 5. Plans for 1979 | 26 |
| 5.1 Data acquisition | 26 |
| 5.2 Data base modifications | 26 |
| 5.3 Technology transfer, documentation | 28 |
| References | 30 |
| Appendix | |
| FPEIS data base summary (as of December 31, 1978) | 31 |




Preceding page blank

## FIGURES


| Number | | Page |
|---|---|---|
| 1.1 | Original FPEIS conceptual structure . . . . . | 4 |

TABLES


| Number | | Page |
|---|---|---|
| 1.1 | Original FPEIS Data Elements | 5 |
| 1.2 | Present FPEIS Data Elements (December 31, 1978) | 6 |
| 3.1 | Type of Operation - New Entries | 14 |
| 3.2 | Feed Material Class - New Entries | 14 |
| 3.3 | Operating Mode Class - New Entries | 14 |
| 3.4 | Device Category - New Entries | 15 |
| 3.5 | Device Commercial Name - New Entries | 15 |
| 3.6 | Measurement Instrument/Method Name - New Entries | 16 |
| 3.7 | Chemical ID - New Entries | 16 |
| 4.1 | Source Category | 18 |
| 4.2 | Type of Operation | 18 |
| 4.3 | Feed Material Class | 19 |
| 4.4 | Operating Mode Class | 20 |
| 4.5 | Generic Device Type | 21 |
| 4.6 | Device Class | 21 |
| 4.7 | Device Category | 22 |
| 4.8 | Device Commercial Name | 23 |
| 4.9 | Measurement Instrument/Method Name | 24 |
| 4.10 | Chemical Species | 25 |

# SECTION 1

# INTRODUCTION

The Fine Particle Emissions Information System (FPEIS) is a computerized data base which contains information on primary fine particle emissions from stationary sources. The purpose of the FPEIS is to provide a centralized source of fine particle sizing data for use by engineers and scientists engaged in particulate control technology development and in the environmental assessment of energy and industrial processes. Following several months of testing and development, the FPEIS was declared operational in January 1977 and has since become a routinely used source of particle sizing data by various offices of the Environmental Protection Agency (EPA), contractors, and others. The purpose of this annual report is to describe the changes made to the FPEIS during 1978 and to outline plans for future development of the FPEIS data base in 1979.

## 1.1 ORIGIN OF THE FPEIS

To describe the evolution of the FPEIS to its present form, it is necessary to briefly examine the origin of the FPEIS. Development of the FPEIS was initiated in early 1975 principally to update the Fine Particle Inventory[1/] which had been developed by Midwest Research Institute (MRI) for EPA in 1971. In the years following publication of the Fine Particle Inventory, several questions were raised about the validity of the data due to limitations of then existing sampling techniques. Moreover, advances in particle sizing measurement technology and a growth in fine particle sampling activities prompted EPA's Industrial Environmental Research Laboratory at Research Triangle Park, North Carolina (IERL/RTP) to initiate a comprehensive revision of the MRI Fine Particle Inventory.

Early in the inventory revision work the decision to develop a computerized inventory was made and the concept of the FPEIS was born. In addition to containing fine particle sizing data, the FPEIS was designed to contain a broad, yet comprehensive description of the entire sampling activity. This description would include source process information, control device characteristics, discussion of the sampling equipment or method used to collect the data, and the results of any physical, chemical, or biological analyses performed on the collected samples. Such data would enable the user to evaluate

more effectively the emissions data relative to the user's specific objectives. To enable an orderly and rapid retrieval of information to be made and to provide compatibility with other EPA data bases, the FPEIS used the same categorization scheme for sources as the National Emissions Data System (NEDS) (i.e., the Source Classification Codes)[2] and utilized the SAROAD/SOTDAT[3] pollutant codes to describe chemical species identified. In addition, a standard protocol for terminology and units was established for selected data to be stored in the FPEIS which were not addressed by other existing data systems. As will be discussed later, this protocol has been modified to reflect changes in user requirements.

During the past 3 years, extensive documentation on the FPEIS has been issued to the user community. The key documents are the FPEIS Reference Manual[4] and FPEIS User Guide[5] which describe in detail the use of the FPEIS. The first edition of each report was published in June 1976 and was widely distributed. A second edition that completely replaced the first one was published in June 1978 and has received even wider interest and distribution. A number of the June 1978 documents were published in loose-leaf notebooks and have been issued to selected routine users on a numbered basis. These registered copies have been updated automatically as changes to the data base documentation have been implemented. This procedure ensures that routine users of the FPEIS will always have access to current documentation. Other users will be updated through a quarterly publication, the first of which will be issued in late 1979.

From the time that the FPEIS became operational in January 1977 through December 1978, the FPEIS has experienced steady growth in the number and diversity of its users and in the quantity of information stored. Requests for information on data from researchers, academicians, and others have numbered in excess of 10 per month for the last 2 years. In those 24 months, the number of site tests reported has doubled and the number of sampling runs has tripled. This reflects the growth of R&D interest in fine particle emissions and their control. Indications are that this growth will continue as particle size-related environmental regulations are contemplated.

## 1.2 STRUCTURE OF THE FPEIS

The basic FPEIS data set may be defined as a group of discrete sampling events which describes fine particle sizing activities on a single particle laden gas stream at a specified site and for a specified period of time. This data set is called a test series, and each FPEIS test series is identified by a unique test series number by which it may be referenced in the data base. In the most basic sense, the test series describes a site test. Consideration of the time period of the testing is imposed to differentiate among several separate tests at the same site.

The fundamental unit of the data structure is the test run. The test run describes a single, discrete sampling event with a specified measurement instrument or technique. Since it is commonplace to group data according to the sampling location (e.g., control device inlet or outlet) or according to variations in process conditions, the test runs are grouped into test subseries to provide for a more orderly sorting or retrieval of data. The designation of a test subseries may vary among test series and is left to the discretion of the encoder of the data.

The structure of the FPEIS as originally conceptualized is given in Figure 1.1. The grouping of data types by structural level is shown here. While the grouping of data elements has changed and new data elements have been added during the last 2 years, the basic structure of the FPEIS test series has remained unchanged.

## 1.3 FPEIS ORGANIZATION

As originally developed, the FPEIS data were grouped into five general categories of information as shown in Table 1.1. These categories include: source characteristics and test series related information; control system description; process characteristics; biological, physical, and chemical analyses; and particle size measurement equipment and data. Table 1.1 also identifies the specific data elements which were contained in each grouping of data when the data base was established. Many of these data elements have been changed or deleted, and other data elements have been added as the FPEIS has evolved.

The present FPEIS organization is shown by Table 1.2. While the same general groupings of data have been retained as shown, the FPEIS now contains data elements that provide a much greater level of comprehensiveness in terms of particle data descriptiveness. This detail reflects an increased need by researchers for complete source characterization. The rationale for these changes and the specifics of each change are discussed in the following section of this annual report.

## 1.4 FPEIS TECHNOLOGY TRANSFER

The publication of a second edition of the FPEIS Reference Manual and User Guide during 1978 was mentioned earlier. This was not, however, the only information transfer activity conducted during the year. An introductory brochure which described the FPEIS was prepared in June 1978 for distribution at the Air Pollution Control Association meeting in Houston, Texas. This brochure was also made available to attendees at numerous other meetings and symposia at which IERL/RTP distributed literature. The response to the brochure was excellent. The entire supply of available bound Reference Manuals and User Guides was exhausted by the middle of December following their publication in July.

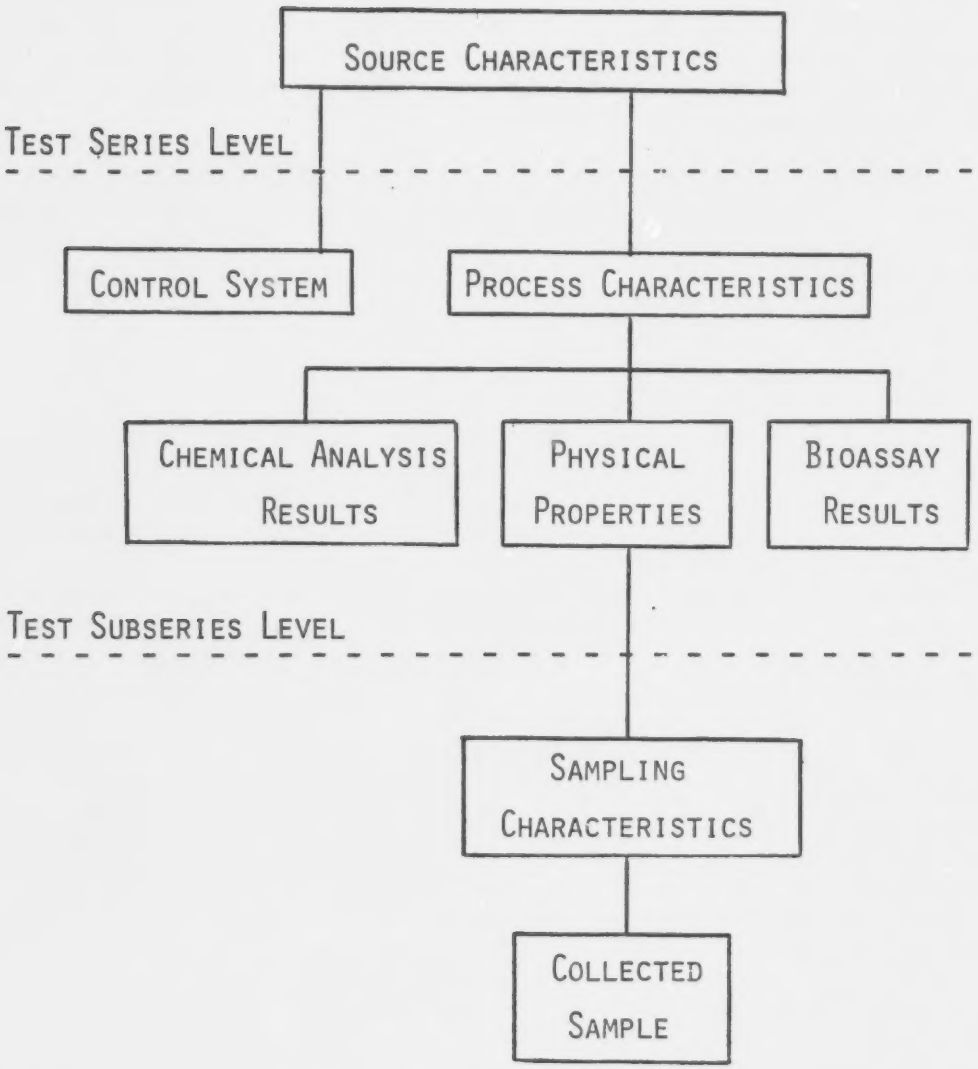



Figure 1.1. Original FPEIS conceptual structure.

TABLE 1.1. ORIGINAL FPEIS DATA ELEMENTS

1. SOURCE CHARACTERISTICS
   - Source Category
   - Type of Operation
   - Feed Material Class
   - Operating Mode Class
   - Source Name
   - Site Name
   - UTM Zone Location and Coordinates
   - Source Address (Street, City, State, Zip Code)
   - Test Series Remarks

2. CONTROL DEVICES
   - Generic Device Type
   - Device Category
   - Device Commercial Name
   - Manufacturer
   - Device Description
   - Design Spec. - Type and Value
   - Operating Parameter - Type & Value

3. PROCESS CHARACTERISTICS
   - Subseries Number
   - Subseries Test Date
   - Subseries Start & Finish Time
   - Sampling Location and Description
   - Source Operating Mode
   - Source Operating Rate
   - Feed Material Composition
   - Volumetric Flow Rate
   - Gas Temp. & Pressure at Samp. Loc.
   - Moisture Content
   - Percent Isokinetic Sampling
   - Gas Composition
   - Trace Gases in ppm
   - Subseries Remarks

4. BIOASSAY TESTING, CHEMICAL ANALYSES, PHYSICAL PROPERTIES
   - Mass Train -- Total Mass Conc.
   - Mass Train -- Front Half Mass Conc.
   - Mass Train Comments
   - Bioassay Test Type
   - Bioassay Test Remarks & Results
   - SAROAD Chemical ID
   - Chemical Analysis Method
   - Conc. in Range above 10 μm
   - Conc. in Range 10 to 1 μm
   - Conc. in Range 1 to 0.1 μm
   - Conc. in Range 0.1 to 0.01 μm
   - Conc. in Range below 0.01 μm
   - Filter/Total Concentration

5. PARTICLE SIZE EQUIPMENT AND DATA
   - Run Number
   - Measurement Equipment Type
   - Size Range Lower and Upper Limit
   - Substrate
   - Sampling Start Time and Duration
   - Sampling Flow Rate
   - Dilution Factor
   - Sampling Train Temp. and Pressure
   - Percent Moisture
   - Particle Diameter Basis
   - Concentration Basis
   - Upper Diameter Boundary
   - Density - Value & How Determined
   - Resistivity - Value & How Determined
   - Physical Properties Comments
   - Run Comments
   - Diameter Boundary
   - Concentration

TABLE 1.2. PRESENT FPEIS DATA ELEMENTS (December 31, 1978)

1. SOURCE CHARACTERISTICS
   - Source Category
   - Type of Operation
   - Feed Material Class
   - Operating Mode Class
   - Source Name
   - Site Name
   - UTM Zone Location and Coordinates
   - Source Address (Street, City, State, Zip Code)
   - Test Series Remarks

2. CONTROL DEVICES
   - Generic Device Type
   - Device Category
   - Device Commerical Name
   - Manufacturer
   - Device Description
   - Design Spec. - Type and Value
   - Operating Parameter - Type & Value

3. PROCESS CHARACTERISTICS
   - Subseries Number
   - Subseries Test Date
   - Subseries Start & Finish Time
   - Sampling Location and Description
   - Source Operating Mode
   - Source Operating Rate
   - Feed Material Composition
   - Volumetric Flow Rate
   - Gas Temp. & Pressure at Samp. Loc.
   - Moisture Content
   - Percent Isokinetic Sampling
   - Gas Composition
   - Trace Gases in ppm
   - Subseries Remarks

4. PHYSICAL PROPERTIES AND CHEMICAL ANALYSES
   - Mass Train Conc. -- Total & Front Half
   - Mass Train Comments
   - Resistivity - Value & How Determined
   - Density - Value & How Determined
   - Chemical Entry Code
   - Chemical ID
   - Chemical Analysis Method Code
   - Diameter Boundary
   - Chemical Concentration

5. PARTICLE SIZE EQUIPMENT AND DATA
   - Run Number
   - Measurement Instrument/Method Name
   - Equipment Size Range - Lower & Upper
   - Substrate
   - Sampling Start Time & Duration
   - Sampling Flow Rate
   - Dilution Factor
   - Sampling Train Temperature & Pressure
   - Percent Moisture
   - Particle Diameter Basis
   - Concentration Basis
   - Diameter Boundary
   - Concentration
   - Run Comments

During the year, a number of user briefings were conducted for EPA contractors and for other organizations who might use the FPEIS. Contractors briefings were held in Los Angeles, California, in February; Kansas City, Missouri, in April; and Mountain View, California, in September. Special briefings were given to the State of California Air Resources Board in Sacramento, California, and to the Electric Power Research Institute in Palo Alto, California, in September. Both organizations have indicated interest in the FPEIS and their active participation is expected in 1979. A presentation on the FPEIS was also made to the Air Pollution Control Association Specialty Conference on Emission Factors and Inventories which was held in Anaheim, California, in November.

## 1.5 FPEIS ANNUAL REPORT

In the remaining sections of this annual report, the accomplishments of 1978 will be discussed in detail, including the data base changes and the addition of new data. The plans for 1979 will also be discussed so that the user community may be informed regarding the new features to be made available and be able to voice their comments and suggestions. User input is always actively sought. Without such input, the FPEIS cannot continue to be a useful and usable tool to researchers engaged in the study of fine particles and their control.

## SECTION 2

## DATA BASE MODIFICATIONS

While no major restructuring of the data base was performed in 1978, a great many modifications were implemented to improve its usability. Only those data elements which are classified as "key" elements may be used to qualify data sets, and thus it is important to have the elements in the data base definition classified correctly. During the last year, three data elements, previously classified as "non-key," were determined to be important enough to be classified as "key" elements. These were: 850* - Density; 1650* - Upper diameter boundary; and 1710* - Diameter boundary.

### 2.1 FPEIS MODIFICATIONS

System 2000®, the data base management system which the FPEIS uses, has an option which, if used properly, allows for a much more efficient and economical storage of data elements. Briefly, if certain data elements are expected to take on many different values as the data base is updated, storage locations can be saved in anticipation of these additions. The phrases "with many future additions" and "with some future additions" are used in the data base definition to reserve storage spaces for these elements. The following 13 data elements were so classified:

410* Generic device type
420* Device class
510* Device number
650* Sampling location
781* CO
783* N-2
1010* Control device number
1020* Parameter number 2
1505* Run number
1510* Measurement instrument/method number
1520* Measurement instrument/method name
1600* Measurement size range - lower limit
1610* Measurement size range - upper limit
1640* Particle diameter basis
1710* Diameter boundary

Prior to last year, the FPEIS allowed particle diameter data based on only the Stokes or the classical aerodynamic diameter definition. As more data were entered, however, a more flexible system was needed. Therefore, the aerodynamic impaction diameter definition[6] was added to the other two and the user can now encode data employing any of the three definitions and the series report will include diameter values based on all three definitions.

The FPEIS has been modified to provide considerable flexibility for the identification of chemical species when data are to be encoded. This flexibility is in recognition of the fact that there presently exists a variety of ways to identify a particular element or compound. The chemical ID used in reporting chemical data is likely to be one with which the user is most familiar. A user's familiarity with a chemical ID scheme will be due largely to the nature of the project on which he is working. The FPEIS now enables users to choose from among three chemical ID schema when they encode their data. These are the SAROAD/SOTDAT system, the Chemical Abstracts Services (CAS) Registration Numbers,[7] and the Multimedia Environmental Goals (MEG) for Environmental Assessment Number.[8] To implement these changes, two data elements were changed and seven were added. Those elements changed were 1410* - Chemical ID; and 1420* - Analysis method. The data elements added were:

1405* Chemical entry code
1820* MEG number
1830* CAS number
1840* Preferred name
1860* Empirical formula
1870* Molecular weight

In addition, a new repeating group, 1850* - Synonyms, was added which includes element 1851* - Other names. Briefly then a substantial change to the SAROAD/SOTDAT table (1800*) repeating group was made to provide the needed flexibility for chemical identifications. These changes also required the dropping of two data elements (1300* and 1448*) referring to data gathered on the ninth stage of a collector. Along with these changes, data input form No. 5, which included both bioassay and chemical data, was split into two--forms 5a and 5b--with form 5a being reserved for future bioassay data and form 5b used exclusively for chemical data.

## 2.2 FPEIS DOCUMENTATION UPDATE

Improvements in the organization and efficiency of the data base would be worthless unless the manner in which data could be entered into and retrieved from the data base was clear to the user. Toward this end, both the FPEIS Reference Manual and User Guide were completely rewritten, with clarity

and completeness as the major goals. All examples of data encoding were redone to insure that field specifications and standard nomenclature requirements were met. The definitions of test series and subseries, concepts which have always been sources of confusion, were expanded and clarified. The section on "Labor Saving Features" was expanded and detailed examples were presented so as to enable the user to better utilize this important feature of the FPEIS. The ability of the FPEIS to protect confidential or proprietary source data was emphasized and the manner in which such data could be encoded was clarified. Those data elements which can be so encoded include the following:

150* Source name
160* Site name
170* Zone location
180* UTM-X
190* UTM-Y
200* Address
210* City
220* State
230* Zip code

Computerized information systems like the FPEIS require that some standardization of data be present in order for specific data selection to be made. Computers search for and select data by comparing the selected value to a known value. When alphanumeric characters are used, such as in the name of a control device, the known value and the selected value must match exactly. For example, if a search is made for the value "ESP," all entries in the data base whose value is "ESP" will be selected; however, entries having the value "ELECTROSTATIC PRECIPITATOR" will not, although it is technically correct. Insofar as the computer is concerned, the two data are not equal and the selection will fail.

To ensure that uniform selection criteria are possible, the FPEIS uses standard nomenclature for certain data elements. For these data elements, the encoder must select terms from a specified list to describe the data of interest. As was expected, the standard nomenclature provided in the User Guide for some of these data elements has proven insufficient, so certain additions to the lists of allowable terms have been made. In Table 2.1-7, Device Category Key Words, the terms "Venturi-variable throat" (Wet scrubber) and "High temperature" (Fabric filter) were added. A number of additions were made to Table 2.1-8, Design Specification Type. The term "Design pressure (absolute)" was added to the lists of three devices: Cyclone, scrubber, and fabric filter. Ten specifications were added to the ESP list. These were: total ESP length, total ESP width, number of baffled sections, plate height, plate-plate spacing, number wires per section, wire-wire spacing, wire diameter, rapping intensity,

and design pressure (absolute). The following additions were also made to the ESP list of Table 2.1-9, Device Operating Parameter Type: number wires per section, wire-wire spacing, and wire diameter.

Because of the expansion of the SAROAD/SOTDAT table in the FPEIS, it became necessary for the encoder to specify which chemical ID scheme was being used with the data. Thus a new data element-chemical entry code-was created, and the standard nomenclature for this element is given in the new Table 2.1-10.

Certain inconsistencies and errors were noted in the standard nomenclature for measurement equipment (Table 2.1-13), and these were corrected when the User Guide was rewritten. Additions were also made to this table as data submitted to the FPEIS included new types of measurement equipment not previously included in the standard nomenclature. The "Brink Model B Impactor" and the "MRI Model 1502 Impactor" were added to the list of standard impactors, while the "CNC/Diffusion Battery," the "SASS Train-without Cyclones," and the "SASS Train-with Cyclones" were added to the list of miscellaneous measurement equipment.

Section 2.3 of the User Guide, Encoding Instructions, was rewritten to improve accuracy and clarity, and the FPEIS Quality Assurance Program, described in Section 3.1 of the User Guide, was more fully explained.

In order to simplify the retrieval of data from the FPEIS data base, a catalog of predefined programs was developed as a user aid. Each program or procedure is identified by a unique number and is called a System Request Command (SRC). The SRCs will allow users to obtain reports without having special expertise in either UNIVAC data processing or SYSTEM 2000 data base management system natural language. This feature should greatly enhance the usefulness and usability of the FPEIS to a wide audience of users. In the last year, the following six SRCs were developed for the benefit of both on-line and off-line users:

SRC-1 FPEIS SERIES Report
SRC-2 FPEIS SUMMARY Report
SRC-3 Fractional Penetration Program (PENTRA)
SRC-4 TALLY WHERE, TALLY ALL
SRC-5 PRINT WHERE
SRC-6 Chemical Data Search (CHEMSEARCH)

The easiest way for off-line users to retrieve data is to request one of these SRCs through the FPEIS project officer. However, it was realized that, in some cases, the specific needs of a user would not be satisfied by any of the SRCs. For this reason, a section on special data retrieval requests was added to clarify the requesting procedure.

Most users of the FPEIS are expected to be off-line users, i.e., users who request, in writing, data retrieval from the FPEIS project officer. However, many users will be either EPA personnel or EPA contractors who will have access to the National Computer Center (NCC) at Research Triangle Park, North Carolina. For these users, the entire section concerning on-line request procedures was rewritten, with many new sections added. For instance, an entire subsection on NCC user qualifications and services registration was written to clarify the registration procedure and to illustrate the proper use of the User ID and Password. An entirely new subsection on interactive (demand) terminal operation was added with examples of beginning and ending a demand session as well as accessing the FPEIS data base. This new subsection included a table of remote interface control statements specific to the UNIVAC 1100 system employed by the NCC. A table of NCC demand access telephone numbers was also added for the benefit of qualified users. The subsection on remote batch terminal operation was expanded and now includes a list of terminals presently supported by the NCC. A table of remote batch access telephone numbers was also added to this subsection.

Prior to 1978, only one SRC was available. This was the FPEIS SUMMARY Report, and it was available only off-line through the FPEIS project officer. As was mentioned before, in the last year, the catalog of SRCs was expanded to six and all are available to both off-line and on-line users. The section of the User Guide discussing these SRCs was rewritten to reflect this expansion. Since most SRCs would be applicable to both demand and batch processing, step-by-step procedures for executing each SRC in both modes were presented. All input requirements are given and several sample outputs produced by the SRC are shown. All of the SRCs except SRC-2 (FPEIS SUMMARY Report) are applicable to demand processing, while the first three SRCs (SERIES Report, SUMMARY Report, and PENTRA) are applicable to remote batch processing. SRC-3, the Fractional Penetration Program (PENTRA), was not completely operational when the manuals were printed, and its subsection was to be added later.

In summary, while the data base structure itself was not altered significantly, it is felt that the new documentation and the modifications made to the techniques of data input and retrieval will greatly enhance the usefulness of the FPEIS.

## SECTION 3

## DATA ADDITIONS

The FPEIS Data Base experienced a rapid growth in 1978 with 67 new test series being added to the 53 already contained in the system (a 126% increase). The increase in the number of individual test measurements or runs was even greater, as 1,228 runs were added to the original 752 runs, representing an increase of 163%. Such growth is an indication of the acceptance which the FPEIS Data System has gained in the scientific and engineering community.

The number of test series or runs added during the last year does not show the increase in the variety of information available in the FPEIS. For instance, four new types of operation (SYSTEM 2000 element C120) were included in the data added during 1978. These are shown in Table 3.1. The 1978 data acquisitions also included 11 new Feed Material Classes (C130) and 10 new Operating Mode Classes (C140). These additions are shown in Tables 3.2 and 3.3, respectively. Information on one new Device Class (C420), namely "prototype," was included in the data gathered in 1978. Fourteen new Device Categories (C430), 12 new Device Commercial Names (C440), and eight new Measurement Instrument/Method Names (C1520) were among the data acquired last year. These additions are shown in Tables 3.4, 3.5, and 3.6, respectively.

The amount of chemical data included in the FPEIS grew as information on 15 new species were added to the 20 already found in the FPEIS. These new chemical species are given in Table 3.7.

Certainly it can be said that the data acquired in 1978, in expanding the variety of information available to the user community, has made the FPEIS an invaluable research tool for those scientists and engineers engaged in fine particle control technology development and in the environmental assessment of industrial processes.

TABLE 3.1. TYPE OF OPERATION - NEW ENTRIES

| |
|---|
| LAB ANALYSIS |
| PETROLEUM INDRY |
| PROTOTYPE TEST |
| WOOD PRODUCTS |

TABLE 3.2. FEED MATERIAL CLASS - NEW ENTRIES

| |
|---|
| CEMENT MFG DRY |
| CEMENT MFG WET |
| CERAMIC/CLAY MFG |
| COKE |
| DIESEL FUEL |
| DISTILLATE OIL |
| MINERAL WOOL |
| PROCESS HEATER |
| STEEL FOUNDRY |
| SULFATE PULPING |
| WOOD |

TABLE 3.3. OPERATING MODE CLASS - NEW ENTRIES

| |
|---|
| GAS |
| KILNS |
| KILNS-GAS FIRED |
| RECIPROCATING |
| RECVY BOLR/OCEVAP |
| SMELTING |
| WOOD WASTE BOILER |
| >100 MMBTU PULVDRY |
| 10-100 MMBTU/HR |
| 10-100 MMBTU/HR STKR |

TABLE 3.4. DEVICE CATEGORY - NEW ENTRIES

| | |
|---|---|
| ESP | - COLDSIDE |
| | DRY, COLDSIDE, HI VOLTAGE |
| | DRY, HOTSIDE, PLATE, DOUBLE CHAMBER |
| | DRY, COLDSIDE, PLATE, DOUBLE CHAMBER |
| | DRY, COLDSIDE, PLATE, SINGLE CHAMBER |
| | DRY |
| | HOTSIDE |
| | HOTSIDE, DRY, PLATE |
| | WET, HOTSIDE |
| | WET, HOTSIDE, LOW VOLTAGE |
| Cyclone | - SINGLE |
| Wet Scrubber | - VENTURI-VARIABLE THROAT |
| Fabric Filter | - CONTINUOUSLY CLEANED, REVERSE AIR |
| | INTERMITTENTLY CLEANED |

TABLE 3.5. DEVICE COMMERCIAL NAME - NEW ENTRIES

| |
|---|
| BRAXTON SONIC AGGLOMERATOR |
| CLNB HI EFFCY AIR FLTR (CHEAF) |
| COTRELL PRECIPITATOR TYPE RSP |
| DUST COLLECTOR |
| GRAVEL BED FILTER |
| KINPACTOR 10X56 VENTURI SCRUBBER |
| MOBILE BAGHOUSE |
| MULTI CYCLONE |
| SPRAY TOWER |
| THERM-O-FLEX FILTERS |
| TURBULENT CONTACT ABSORBER, TCA |
| VENTURI |

TABLE 3.6. MEASUREMENT INSTRUMENT/METHOD NAME - NEW ENTRIES

| |
|---|
| BAUSCH AND LOMB MODEL 40-1-OPC |
| CLIMET MODEL-OPC |
| MRI MODEL 1502 |
| ROYCO MODEL-OPC-225 |
| SASS TRAIN |
| SASS TRAIN-WITH CYCLONES |
| WHITBY ELECTRICAL ANALYZER-3030 |
| WIRE SCREEN DIFFUSION BATTERY |

TABLE 3.7. CHEMICAL ID - NEW ENTRIES

| |
|---|
| POLYNUCLEAR HYDROCARBONS (HETEROCYCLIC) |
| ALUMINUM |
| BARIUM |
| CARBON |
| LITHIUM |
| PHOSPHORUS |
| SELENIUM |
| TITANIUM |
| POTASSIUM |
| SODIUM |
| FLUORIDE ION |
| CHLORIDE ION |
| NITRATE ION |
| SULFATE ION |
| SULFITE ION |

## SECTION 4

## FPEIS DATA BASE: STATE-OF-THE-ART SUMMARY

As of December 31, 1978, the FPEIS Data System included information on 120 test activities (test series) and 1980 individual test measurements (test runs). The amount of information the FPEIS now includes on sources, control and measurement methods and devices, and particulate and chemical analyses is of sufficient variety to make the FPEIS Data System a valuable resource for engineers and scientists interested in fine particle processes.

As an example of this variety, five specific Source Categories can be found in the FPEIS. These are listed in Table 4.1. Fourteen Types of Operation, 32 Feed Material Classes, and 34 Operating Mode Classes are represented in the FPEIS. These are given in Tables 4.2, 4.3, and 4.4, respectively. Information on many different control devices is stored in the FPEIS. For instance, data on seven Generic Device Types, four Device Classes, 31 Device Categories, and 33 Device Commercial Names can now be found in the FPEIS. These items are listed in Tables 4.5, 4.6, 4.7, and 4.8, respectively. In addition, 18 different Measurement Instruments or Methods are included in the FPEIS. These are listed in Table 4.9. Finally, information concerning 35 different chemical species can be found in the FPEIS. Table 4.10 lists these different species.

As these 10 tables should show, the FPEIS has become a comprehensive fine particle information data base which should, now and in the future, be of much help to those scientists and engineers of the user community.

A summary of the contents of the FPEIS data base as of December 31, 1978, is provided in the Appendix. As new test data are added to the FPEIS, the data base will be updated.

TABLE 4.1. SOURCE CATEGORY

| |
|---|
| EXTCOMB BOILER |
| INDUSTRIAL PROCES |
| INTERNLCOMBUSTION |
| LABORATORY |
| SOLID WASTE |

TABLE 4.2. TYPE OF OPERATION

| |
|---|
| CHEMICAL MFG |
| COMMERCL-INSTUTNL |
| DEVICE EVALUATION |
| ELECTRIC GENERATN |
| FOOD/AGRICULTURAL |
| GOVERNMENT |
| INDUSTRIAL |
| LAB ANALYSIS |
| MINERAL PRODUCTS |
| PETROLEUM INDRY |
| PRIMARY METALS |
| PROTOTYPE TEST |
| SECONDARY METALS |
| WOOD PRODUCTS |

TABLE 4.3. FEED MATERIAL CLASS

| |
|---|
| AL ORE-ELECROREDN |
| ANTHRACITE COAL |
| ASPHALT BATCHING |
| ASPHALT ROOFING |
| BITUMINOUS COAL |
| CEMENT MFG DRY |
| CEMENT MFG WET |
| CERAMIC/CLAY MFG |
| COAL |
| COKE |
| COKE-MET BYPRODUC |
| COPPER SMELTER |
| COTTON GINNING |
| DIESEL FUEL |
| DISTILLATE OIL |
| FERTILIZER-UREA |
| GRAY IRON |
| INCINERATOR |
| LEAD SMELTERS |
| MINERAL WOOL |
| PHOS-ACID THERMAL |
| POTASSIUM CHLORID |
| PROCESS HEATER |
| PULP/PAPER MILL |
| RESIDUAL OIL |
| SALT MINING |
| SOLID WASTE/COAL |
| STEEL FOUNDRY |
| STEEL PRODUCTION |
| SULFATE PULPING |
| WOOD |
| ZINC SMELTING |

TABLE 4.4. OPERATING MODE CLASS

| |
|---|
| BATTERY CONDENSER |
| BLAST FURNACE |
| CALCINATION |
| CONVERTING |
| CUPOLA |
| DRYING |
| DUST FEEDER |
| ELECTRIC ARC NOLANCE |
| GAS |
| KILNS |
| KILNS-GAS FIRED |
| LIME KILNS |
| OPENHEARTH OXLANCE |
| OVEN CHARGING |
| PRILLING TOWER |
| PULVERIZED COAL |
| RECIPROCATING |
| RECVY BOLR/OCEVAP |
| ROASTING |
| ROASTING/REVERBERATI |
| ROTARY DRYER |
| ROTARY SALT DRYER |
| SALT DRYERS/MILLS |
| SELF-BAKING |
| SINTERING |
| SMELTING |
| STOKER |
| VERT RETORTS |
| WOOD WASTE BOILER |
| >100 MBTU PULVERIZED |
| >100 MMBTU PULVDRY |
| >100 MMBTU/HR |
| 10-100 MMBTU/HR |
| 10-100 MMBTU/HR STKR |

TABLE 4.5. GENERIC DEVICE TYPE

| |
|---|
| CYCLONE |
| ESP |
| FABRIC FILTER |
| AFTERBURNER |
| SETTLING CHAMBER |
| SPRAY CHAMBER |
| WET SCRUBBER |

TABLE 4.6. DEVICE CLASS

| |
|---|
| CONVENTIONAL |
| NOVEL |
| PILOT SCALE |
| PROTOTYPE |

TABLE 4.7. DEVICE CATEGORY

| | |
|---|---|
| ESP | - COLDSIDE |
| | DRY |
| | DRY, COLDSIDE, HI VOLTAGE |
| | DRY, HOTSIDE, PLATE, DOUBLE CHAMBER |
| | DRY, COLDSIDE, PLATE, DOUBLE CHAMBER |
| | DRY, COLDSIDE, PLATE, HI VOLTAGE, DOUBLE CHAMBER |
| | DRY, COLDSIDE, PLATE, SINGLE CHAMBER |
| | HOTSIDE |
| | HOTSIDE, DRY, PLATE |
| | PIPE |
| | PLATE |
| | WET |
| | WET, HOTSIDE |
| | WET, HOTSIDE, LOW VOLTAGE |
| Cyclone | - MULTIPLE |
| | SINGLE |
| Wet Scrubber | - CENTRIFUGAL |
| | COMBINATION |
| | FIBROUS PACKING |
| | GAS ATOMIZED SPRAY |
| | IMPINGEMENT |
| | MOVING BED |
| | PREFORMED SPRAY |
| | VENTURI-VARIABLE THROAT |
| Fabric Filter | - CONTINUOUSLY CLEANED, REVERSE AIR |
| | INTERMITTENTLY CLEANED |
| | MECHANICAL SHAKE |
| | REVERSE AIR |

TABLE 4.8. DEVICE COMMERCIAL NAME

| |
|---|
| AERONETICS TWO-PHASE JET SCRUB |
| AFTERBURNER |
| BAGHOUSE |
| BAGHOUSE (PILOT UNIT) |
| BRAXTON SONIC AGGLOMERATOR |
| CENTRIFIELD SCRUBBER |
| CLNB HI EFFCY AIR FLTR (CHEAF) |
| COTRELL PRECIPITATOR TYPE RSP |
| CYCLONE |
| DUST COLLECTOR |
| DYNACTOR SCRUBBER |
| ESP |
| GRAVEL BED FILTER |
| IMPINJET WET SCRUBBER |
| KINPACTOR 10X56 VENTURI SCRUBBER |
| KOCH FLEXITRAY |
| LONE-STAR STEEL STEAM-HYDRO |
| MGOX SCRUBBER |
| MOBILE BAGHOUSE |
| MULTICYCLONE |
| MULTIVANE SCRUBBER |
| PENTAPURE SCRUBBER |
| SECONDARY COLD CYCLONE |
| SPRAY TOWER |
| TCA SCRUBBER |
| THERM-O-FLEX FILTERS |
| TURBULENT CONTACT ABSORBER,TCA |
| VENTURI SCRUBBER |
| VENTURI-ROD SCRUBBER |
| WET SCRUBBER |
| WETTED FIBER SCRUBBER |

TABLE 4.9. MEASUREMENT INSTRUMENT/METHOD NAME

| |
|---|
| ANDERSEN MODEL II IMPACTOR |
| ANDERSEN MODEL III IMPACTOR |
| ANDERSEN MODEL IV IMPACTOR |
| BAUSCH AND LOMB MODEL 40-1-OPC |
| BRINK BMS-11 IMPACTOR |
| BRINK BMS-11 IMPACTOR, MODIFIED |
| BRINK MODEL B IMPACTOR |
| CLIMET MODEL-OPC |
| CNC/DIFF BATTERY |
| ELECTRICAL ANALYZER TS M-3030 |
| MRI MODEL 1502 |
| RICH 100-CNC |
| ROYCO MODEL-OPC-225 |
| SASS TRAIN |
| SASS TRAIN-WITH CYCLONES |
| UW MARK III IMPACTOR |
| WHITBY ELECTRICAL ANALYZER 3030 |
| WIRE SCREEN DIFF BATTERY |

TABLE 4.10. CHEMICAL SPECIES

| |
|---|
| POLYNUCLEAR HYDROCARBONS (HETEROCYCLIC) |
| ALUMINUM |
| ANTIMONY |
| ARSENIC |
| BERYLLIUM |
| BARIUM |
| CADMIUM |
| CALCIUM |
| CHROMIUM |
| COBALT |
| COPPER |
| CARBON |
| IRON |
| LEAD |
| MANGANESE |
| NICKEL |
| LITHIUM |
| MAGNESIUM |
| MERCURY |
| PHOSPHORUS |
| SELENIUM |
| TIN |
| TITANIUM |
| VANADIUM |
| SILICON |
| ZINC |
| TELLURIUM |
| THALLIUM |
| POTASSIUM |
| SODIUM |
| FLUORIDE ION |
| CHLORIDE ION |
| NITRATE ION |
| SULFATE ION |
| SULFITE ION |

# SECTION 5

# PLANS FOR 1979

## 5.1 DATA ACQUISITION

It is expected that the FPEIS will undergo considerable growth during 1979 in terms of the number sites tested and the number of sampling runs per site. Since June 15, 1978, all new IERL/RTP projects which involve particle sampling are required to encode and enter the results from those tests into the FPEIS data base. As these projects become active, data from them will be entered routinely into the data base. In addition, 1979 will mark the entry of the initial data from the ongoing IERL/RTP Environmental Assessment Program.

Data acquisition is not expected to be limited to IERL/RTP. The emergence of an Office of Research and Development (OR&D) sampling support program for the Inhalable Particulate Matter (IPM) standard development will provide additional particle sizing data for the FPEIS. It is currently expected that the FPEIS will be a significant decision aid to OR&D personnel in setting priorities for such an IPM sampling program; i.e., how much data are known for specific sources, what sources are missing from the FPEIS, etc. Personnel from IERL/RTP and IERL/Ci will be active in this work.

Some carryover work from 1978 will produce some data from power plant tests sponsored by the U.S. Department of Energy (DOE). Additional DOE test data will be solicited as part of the IERL/RTP Environmental Assessment Program. Data will also be sought from environmental agencies in many states. A substantial quantity of particle sizing data was collected by the State of California Air Resources Board. Plans to acquire these data in 1979 are being developed.

## 5.2 DATA BASE MODIFICATIONS

As in 1978, the structure of the FPEIS data base will undergo major revisions in 1979; however, the impact upon the present data in the FPEIS is not expected to be too great. Most of the revisions will involve the addition of new features for which no data received to date have been reported. These revisions are prompted by the need to render the FPEIS compatible with the other elements of the Environmental Assessment Data Systems (EADS) now being developed and scheduled for implementation during 1979.

The EADS is a group of computerized data bases which describe the multimedia waste discharge characteristics of various industrial and energy processes. The FPEIS is the first of these waste stream data bases to become operational. The other data bases for gaseous emissions, liquid effluents, and solid discharges are currently being developed and implemented. When they are fully operational, they will all use the same nomenclature protocol. This multimedia character of the EADS has necessitated some changes to the protocol used by the FPEIS. The expected changes are described in the following discussion for each data grouping.

### 5.2.1 Source Characteristics

During 1979, the NEDS Source Classification Codes will be replaced by the Environmental Assessment Source Classification System (EASCS), which has been developed by IERL/RTP. The EASCS will merge terminology used by EPA program offices and R&D components into a single, cohesive source categorization scheme. The emphasis will be placed on using colloquial nomenclature wherever possible. The specific data to be reported will include Source Category, Source Type, Product or Device, and Process Type. Data elements will also be added for Design Process Rate and Units and for Feed Material Category.

Other data elements to be added to this data group include the EPA contract number and task order/technical directive number. These data will provide references to management information on EPA projects which may exist in other data systems. References to the other EADS data bases which contain data taken at the same time and site will also be added. The data elements will be the Test Series Numbers for the gaseous emissions, liquid effluents, and solid discharge data bases which correspond to the same site location and testing period as the FPEIS data. In this way, references to multimedia data will be available to the FPEIS users.

Plans are also under way to delete the Universal Transverse Mercator (UTM) coordinates data from the FPEIS. Few data on these data elements have been reported, so the impact will be slight. More important, perhaps, is the fact that IERL/RTP's mission relates to discharges from generic process sources and the development of control technologies to reduce such discharges. The identity or location of the source is not essential or even relevant to the laboratory's objectives; therefore, the need for these data no longer exist.

### 5.2.2 Control System Description

Several changes are contemplated here to improve the flexibility available to users. The principal change planned involves replacing the Device Description data element with a group of key words which could be selected and retrieved independently. For example, typical key words for an ESP could include "hot side" or "parallel plate."

Other proposed changes include establishing greater detail in the control device nomenclature in the documentation and providing a more general classification of control systems.

### 5.2.3 Process Characteristics

This data grouping will undergo a number of changes during 1979. Additional parameters relating to source process conditions will be included, but the most significant change will involve the addition of data elements to describe the character of the process fuel or feedstock. This will include proximate analysis and ultimate analysis of fuels as well as identification of inorganic and organic species in fuels or feedstocks. These data will enable users to perform material balance calculations on the process being sampled.

### 5.2.4 Biological, Physical, and Chemical Analyses

The changes with the greatest implications are planned for this data grouping, but this is due in part to the fact that knowledge was inexact about the analyses to be performed or how the data were to be reported. This is particularly true for the biological assay of collected fine particle samples. In 1979, a reporting protocol for biological and ecological data will be implemented in order to support the IERL/RTP Level 1 Environmental Assessment Program.[9] In addition, growing concern about the emission of natural-occurring radioisotopes from fossil energy processes and other sources has resulted in plans to develop a radionuclide data reporting protocol. Both the biological and radionuclide protocols will have little impact on the existing data base since few data have ever been collected on fine particles in these areas. The future will likely be dramatically different as comprehensive waste stream characterization becomes more the rule than the exception.

### 5.2.5 Particle Size Measurement Equipment and Data

At present, minor changes are planned for this data grouping which will allow for a more detailed reporting of these data.

## 5.3 TECHNOLOGY TRANSFER, DOCUMENTATION

As the FPEIS grows in scope and use, the need to maintain a well-informed user community grows as well. A major revision of the FPEIS documentation (Reference Manual and the FPEIS User Guide) is scheduled for the summer of 1979. Holders of registered documentation sets will receive the changes automatically. Other users or interested parties will be notified by way of a quarterly update publication.

The first quarterly update issue has been scheduled for late summer or early fall 1979. Each issue will describe changes or enhancements to the FPEIS since the previous one. Also, new data additions will be described and

any new publications will be announced. It is hoped that these quarterly updates will provide a forum for comments and suggestions by the user community, as well as a means of informing the users of new development.

Some special reports, brochures, etc., will be prepared as needed. A new FPEIS brochure will be prepared in the spring of 1979. As noted previously, the brochure has been a very effective means of introducing the FPEIS to the public. A special report on the FPEIS/CIDRS program is planned for late 1979 which will address the use of the FPEIS version of this software package.

## REFERENCES


1. Shannon, L. J., P. G. Gorman, and M. Reichel. Particulate Pollutant System Study, Volume II: Fine Particle Emissions. Midwest Research Institute, EPA No. APTD-0744, NTIS No. PB 203-521, August 1971.

2. Guiding for Compiling a Comprehensive Emission Inventory. EPA No. APTD-1135, NTIS No. PB 212-231, March 1973.

3. SOTDAT Final Report. EPA-450/3-75-070, NTIS No. PB 245-052, July 1975.

4. Schrag, M. P., ed. Fine Particle Emissions Information System Reference Manual. Midwest Research Institute, EPA-600/8-78-007, NTIS No. PB 286-004, June 1978.

5. Schrag, M. P., ed. Fine Particle Emissions Information System User Guide. Midwest Research Institute, EPA-600/8-78-006, NTIS No. PB 285-877, June 1978.

6. Galeski, J. B. Particle Size Definitions for Particulate Data Analysis. Midwest Research Institute, EPA-600/7-77-129, NTIS No. PB 276-470, November 1977.

7. Chemical Abstracts Services Registration Numbers for Chemical Species, American Chemical Society.

8. Cleland, J. G., and G. L. Kingsbury. Multimedia Environmental Goals for Environmental Assessment, Volumes I and II. Research Triangle Institute, EPA-600/7-77-136a, b, NTIS No. PB 276-919, -920, November 1977.

9. Duke, K. M., M. E. Davis, and A. J. Davis. IERL-RTP Procedures Manual: Level 1 Environmental Assessment, Biological Tests for Pilot Studies. Battelle-Columbus Laboratories, EPA-600/7-77-043, NTIS No. PB 268-484, April 1977.

APPENDIX

FPEIS DATA BASE SUMMARY (AS OF DECEMBER 31, 1978)

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 1 | Harris, D. B., and D. C. Drehmel, "Fractional Efficiency of Metal Fume Control as Determined by Brink Impactor," EPA/CSL (1973) | Brink Impactor | Zn Roaster | Wet ESP | 4 |
| 2 | Harris, D. B., and D. C. Drehmel, "Fractional Efficiency of Metal Fume Control as Determined by Brink Impactor," EPA/CSL (1973) | Brink Impactor | Cu Converter | Wet ESP | 4 |
| 3 | Harris, D. B., and D. C. Drehmel, "Fractional Efficiency of Metal Fume Control as Determined by Brink Impactor," EPA/CSL (1973) | Brink Impactor | Zn Sintering | Dry ESP | 2 |
| 4 | Harris, D. B., and D. C. Drehmel, "Fractional Efficiency of Metal Fume Control as Determined by Brink Impactor," EPA/CSL (1973) | Brink Impactor | Pb Sintering | Baghouse (Orlon) | 2 |
| 5 | Harris, D. B., and D. C. Drehmel, "Fractional Efficiency of Metal Fume Control as Determined by Brink Impactor," EPA/CSL (1973) | Brink Impactor | Pb Blast Furnace | Baghouse (wool felt) | 2 |
| 6 | Statnick, R. M., "Measurement of $SO_2$, Particulate, and Trace Elements in a Copper Smelter Converter and Roaster/ Reverberatory Gas Streams," EPA/CSL | Brink and Andersen Impactors | Cu Roaster and Reverberatory Furnace (ASARCO) | Dry ESP (pipe) and Parallel Type ESP | 2 |
| 7 | Statnick, R. M., "Measurement of $SO_2$, Particulate, and Trace Elements in a Copper Smelter Converter and Roaster/ Reverberatory Gas Streams," EPA/CSL | Brink and Andersen Impactors | Cu Converter | Plate Type ESP | 2 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 8 | McCain, J. D., and W. B. Smith, "Lone Star Steel Steam-Hydro Air Cleaning System Evaluation," EPA-650/2-74-028 (1974) | Brink and Andersen Impactors. Optical Particle Counter and Diffusion Battery | Open Hearth Furnace | Lone Star Steel Steam-Hydro Scrubber | 38 |
| 9 | Cooper, D. W., and D. P. Andersen, "Dynactor Scrubber Evaluation," GCA Corporation (1974) | Andersen Impactor | Test Aerosol from Dust Feeder | Dynactor Scrubber | 50 |
| 10 | Harris, D. B., "Tests Performed at Celotex Corporation, Goldsboro, North Carolina | Pilat Impactor | Asphalt Roofing | Afterburner | 1 |
| 11 | Harris, D. B., and J. A. Turner, "Particulate and $SO_2/SO_3$ Measurement Around an Anthracite Steam Generator Baghouse," EPA/CSL (1973) | Brink Impactor | Pulverized Coal-Fired Boiler | Baghouse | 4 |
| 12 | McKenna, J. D., "Applying Fabric Filtration to Coal-Fired Industrial Boilers: A Preliminary Pilot Scale Investigation," Enviro-Systems and Research, Inc. (1974) | Andersen Impactor | Coal-Fired Industrial Boiler | Baghouse | 3 |
| 13 | Cowherd, C. et al., "Hazardous Emission Characterization of Utility Boilers," EPA-650/2-75-066 | Brink Impactor | Utility Boiler | Cyclone | 6 |
| 15 | Statnick, R. M., and D. C. Drehmel, "Fine Particulate Control Using $SO_2$ Scrubbers," EPA (1974) | Brink and Andersen Impactors | Coal-Fired Utility Boiler | TCA Scrubber | 14 |
| 16 | Statnick, R. M., and D. C. Drehmel, "Fine Particulate Control Using $SO_2$ Scrubbers," EPA (1974) | Brink and Andersen Impactors | Coal-Fired Utility Boiler | Venturi Scrubber | 4 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 17 | Statnick, R. M., and D. C. Drehmel, "Fine Particulate Control Using $SO_2$ Scrubbers," EPA (1974) | Brink and Andersen Impactors | Oil-Fired Boiler | Venturi MgO Scrubber | 8 |
| 18 | Riggenbach, J. D., E. D. Johnson, and M. K. Hamlin, "Measurement of Particulate Grain Loadings, Particle Size Distribution, and Sulfur Gas Concentrations at Hoerner Waldorf's Pulp and Papermill No. 3 Recovery System, Vols. I, II, and III, Environmental Science and Engineering, Inc. | Brink Impactor | Pulp and Papermill Recovery Boiler | ESP | 38 |
| 19 | Shannon, L. J. et al., "St. Louis/ Union Electric Refuse Firing Demonstration Air Pollution Test Report" | Brink and Andersen Impactors | Coal-Fired Utility Boiler | ESP | 26 |
| 20 | McCain, J. D., "Evaluation of Aronetics Two-Phase Jet Scrubber," EPA-650/2-74-129 | Brink and Andersen Impactors. Optical Particle Counter, Diffusion Battery + CNC | Ferro-Alloy Electric Arc Furnace | Aronetics Two-Phase Jet Scrubber | 41 |
| 21 | Bosch, J. C., M. J. Pilat, and B. F. Hrutfiord, "Size Distribution of Aerosols From a Kraft Mill Recovery Furnace," Tappi, 54(11):1871 (1971) | Pilat Impactor | Kraft Mill Recovery Furnace | ESP | 4 |
| 22 | McGarry, F. J., and C. J. Gregory, "A Comparison of the Size Distribution of Particulates Emitted from Air, Mechanical, and Steam Atomized Oil-Fired Burners," JAPCA, 22(8):636 (1972) | Andersen Impactor | Air Atomized Oil-Fired Boiler | ESP | 1 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 23 | McGarry, F. J., and C. J. Gregory, "A Comparison of the Size Distribution of Particulates Emitted from Air, Mechanical, and Steam Atomized Oil-Fired Burners," JAPCA, 22(8):636 (1972) | Andersen Impactor | Mechanical Atomized Oil-Fired Boiler | ESP | 1 |
| 24 | McGarry, F. J., and C. J. Gregory, "A Comparison of the Size Distribution of Particulates Emitted from Air, Mechanical, and Steam Atomized Oil-Fired Burners," JAPCA, 22(8):636 (1972) | Andersen Impactor | Steam Atomized Oil-Fired Boiler | ESP | 1 |
| 25 | Lee, R. E., Jr., H. L. Crist, A. E. Riley, and K. E. MacLeod, "Concentration and Size of Trace Metal Emissions from a Power Plant, a Steel Plant, and a Cotton Gin," Env. Sci. and Tech., 9(7):643 (1975) | UW Mark III Impactor | Emissions from a Power Plant | ESP | 2 |
| 26 | Lee, R. E., Jr., H. L. Crist, A. E. Riley, and K. E. MacLeod, "Concentration and Size of Trace Metal Emissions from a Power Plant, a Steel Plant, and a Cotton Gin," Env. Sci. and Tech., 9(7):643 (1975) | UW Mark III Impactor | Emissions from a Steel Plant | Baghouse | 2 |
| 27 | Lee, R. E., Jr., H. L. Crist, A. E. Riley, and K. E. MacLeod, "Concentration and Size of Trace Metal Emissions from a Power Plant, a Steel Plant, and a Cotton Gin," Env. Sci. and Tech., 9(7):643 (1975) | UW Mark III Impactor | Emissions from a Cotton Gin | Wet Scrubber | 2 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 28 | "St. Louis/Union Electric Refuse Fuel Project," MRI Project No. 3821-C(4), January 1975 | Brink and Andersen Impactors | Coal-Fired Utility Boiler | ESP | 67 |
| 29 | "St. Louis/Union Electric Refuse Fuel Project," MRI Project No. 4033-C, Monthly Report No. 1 | Brink and Andersen Impactors | Coal-Fired Utility Boiler | ESP | 12 |
| 30 | "Test and Evaluation Program for St. Louis/Union Electric Refuse Fuel Project," MRI Project No. 4033-C, Monthly Report No. 4 | Brink and Andersen Impactors | Coal-Fired Utility Boiler | ESP | 43 |
| 31 | "Test and Evaluation Program for St. Louis/Union Electric Refuse Fuel Project," MRI Project No. 4033-C, Monthly Report No. 11 | Brink and Andersen Impactors | Coal-Fired Utility Boiler | ESP | 19 |
| 32 | Toca, F. M., "Lead and Cadmium Distribution in the Particulate Effluent from a Coal-Fired Boiler," Ph.D. Thesis, University of Iowa, Ames, Iowa, July 1972 | Andersen Ambient Impactor | Coal-Fired Boiler | ESP | 5 |
| 33 | Baladi, E., "Particle Size Distribution Tests for Beker Industries Corporation," MRI Project No. 5-1379-C | Brink Impactor | Phosphate Rock Calciner | Venturi Scrubber | 5 |
| 34 | Gooch, J. P., and J. D. McCain, "Particulate Collection Efficiency Measurements on a Wet Electrostatic Precipitator," EPA-650/2-75-033 | Brink and Andersen Impactors. Optical Particle Counter, Diffusion Battery, and CN Counter | Aluminum Reduction Cells | ESP Preceded by Spray Towers | 17 |
| 35 | Bradway, R. M., and R. W. Cass, "Fractional Efficiency of a Utility Boiler Baghouse," EPA-600/2-75-013-a | Andersen Impactor | Coal-Fired Boiler | Baghouse | 86 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 36 | McKenna, J. D., J. C. Mylock, and W. O. Lipscomb, "Applying Fabric Filtration to Coal-Fired Industrial Boilers," EPA-650/2-74-058-a | Andersen Impactor | Coal-Fired Boiler | Baghouse | 28 |
| 37 | McKenna, J. D., J. C. Mylock, and W. O. Lipscomb, "Applying Fabric Filtration to Coal-Fired Industrial Boilers," EPA-650/2-74-058-a | Andersen Impactor | Coal-Fired Boiler | Baghouse | 7 |
| 38 | McKenna, J. D., J. C. Mylock, and W. O. Lipscomb, "Applying Fabric Filtration to Coal-Fired Industrial Boilers," EPA-650/2-74-058-a | Andersen Impactor | Coal-Fired Boiler | Baghouse | 5 |
| 39 | McKenna, J. D., J. C. Mylock, and W. O. Lipscomb, "Applying Fabric Filtration to Coal-Fired Industrial Boilers," EPA-650/2-74-058-a | Andersen Impactor | Coal-Fired Boiler | Baghouse | 11 |
| 40 | McKenna, J. D., J. C. Mylock, and W. O. Lipscomb, "Applying Fabric Filtration to Coal-Fired Industrial Boilers," EPA-650/2-74-058-a | Andersen Impactor | Coal-Fired Boiler | Baghouse | 7 |
| 41 | McCain, J. D., "Evaluation of Centrifield Scrubber," EPA-650/2-74-129-a | Brink and Andersen Impactors, Diffusional, Optical, and Electrical Methods | Asphalt Dryer | 1. Coarse Cyclone<br>2. Secondary Collector<br>3. Scrubber | 31 |
| 42 | Cooper, D. W., "Pentapure Impinger Evaluation," EPA-650/2-75-024-a | Andersen Impactor | Gray Iron Foundry | Pentapure Impinger | 12 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 43 | Yost, K. J. et al., "The Environmental Flow of Cadmium and Other Trace Metals," Progress Report NSF (RANN) Grant GI-35106, Purdue University, West Lafayette, Indiana | Andersen Impactor | Zinc Coke Plant | - | 1 |
| 44 | Yost, K. J. et al., "The Environmental Flow of Cadmium and Other Trace Metals," Progress Report NSF (RANN) Grant GI-35106, Purdue University, West Lafayette, Indiana | Andersen Impactor | Zinc Vertical Retort | Baghouse | 3 |
| 45 | Yost, K. J. et al., "The Environmental Flow of Cadmium and Other Trace Metals," Progress Report NSF (RANN) Grant GI-35106, Purdue University, West Lafayette, Indiana | Andersen Impactor | Steel Mill Open Hearth Furnace | ESP | 6 |
| 46 | Yost, K. J. et al., "The Environmental Flow of Cadmium and Other Trace Metals," Progress Report NSF (RANN) Grant GI-35106, Purdue University, West Lafayette, Indiana | Andersen Impactor | Municipal Incinerator | Scrubber | 1 |
| 47 | Brown Jr., A. et al., ERDA Contract No. EX-7-6-C-01-2267 | Andersen Model III Impactor | Nonclassified Boiler | None | 3 |
| 48 | Calvert, S., N. J. Jhaveri, and S. Yung, "Fine Particle Scrubber Performance Tests," EPA-650/2-74-093 | UW Mark II and Andersen Impactors | Urea Prilling Tower | Valve Tray | 12 |
| 49 | Calvert, S., N. J. Jhaveri, and S. Yung, "Fine Particle Scrubber Performance Tests," EPA-650/2-74-093 | UW Mark II and Andersen Impactors | Potash Dryer | Scrubber | 17 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 50 | Calvert, S., N. J. Jhaveri, and S. Yung, "Fine Particle Scrubber Performance Tests," EPA-650/2-74-093 | UW Mark III and Andersen Impactors | Coal-Fired Boiler | TCA Scrubber | 6 |
| 51 | Calvert, S., N. J. Jhaveri, and S. Yung, "Fine Particle Scrubber Performance Tests," EPA-650/2-74-093 | UW Mark III and Andersen Impactors | Coal-Fired Boiler | Venturi Scrubber | 6 |
| 52 | Calvert, S., N. J. Jhaveri, and S. Yung, "Fine Particle Scrubber Performance Tests," EPA-650/2-74-093 | UW Mark III and Andersen Impactors | Salt Dryer | Wetted Fiber Scrubber | 16 |
| 53 | Calvert, S., N. J. Jhaveri, and S. Yung, "Fine Particle Scrubber Performance Tests," EPA-650/2-74-093 | UW Mark III and Andersen Impactors | Salt Dryer | Impingement Plate Scrubber | 12 |
| 54 | Calvert, S., N. J. Jhaveri, and S. Yung, "Fine Particle Scrubber Performance Tests," EPA-650/2-74-093 | UW Mark III and Andersen Impactors | Iron Wetting Cupola | Venturi Rod Scrubber | 18 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 55 | Calvert, S. et al., EPA-600/2-76-282, December 1976 | UW Mark III Impactor | Gray Iron Process | Wet Scrubber | 35 |
| 56 | EPA Contract No. 68-02-1814, Bechtel Corporation, San Francisco, California | MRI Model 1502 and Brink Impactors | Coal-Fired Boiler | Wet Scrubber | 101 |
| 57 | EPA Contract No. 68-02-1814, Bechtel Corporation, San Francisco, California | MRI Model 1502 and Brink Impactors | Coal-Fired Boiler | Wet Scrubber | 75 |
| 58 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Coal-Fired Boiler | NA | 1 |
| 59 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Residual Oil-Fired Boiler | None | 5 |
| 60 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Residual Oil-Fired Boiler | None | 2 |
| 61 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Residual Oil-Fired Boiler | None | 1 |
| 62 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Residual-Oil Boiler | None | 3 |
| 63 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Coal-Fired Boiler | None | 1 |
| 64 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Coal-Fired Boiler | None | 3 |
| 65 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Coal-Fired Boiler | ESP | 5 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 66 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Distillate Oil-Fired Boiler | ESP | 2 |
| 67 | Hunter, S. C. et al., EPA Contract No. 68-02-1074 | Brink Impactor | Residual Oil-Fired Boiler | None | 2 |
| 68 | Ensor, D. S. et al., EPA-600/2-75-074 | Impactor and Wire Screen Diff. Battery | Coal-Fired Boiler | Wet Scrubber | 33 |
| 69 | Schliesser, S. P., EPA Contract No. 68-02-2646 | Brink BMS-II Impactor<br>UW Mark III Impactor | Coal-Fired Boiler | High Voltage ESP | 79 |
| 70 | Stanley, C., North Dakota Trip Report, Inter-Office Memorandum | Brink BMS-II Impactor<br>UW Mark III Impactor<br>Other Impactors | Nonclassified Boiler | High Voltage ESP | 30 |
| 71 | Snyder, J. W., et al., EPA 68-02-1816, Report 5, Nov. 1977 | Andersen Model III Impactor<br>Brink BMS-II Impactor | Coal-Fired Boiler | Mobile Fabric Filter | 18 |
| 73 | Bradway, R. M. et al., EPA-600/2-76-077A | Andersen Impactor | Nonclassified Boiler | Fabric Filter | 38 |
| 74 | Bradway, R. M. et al., EPA-600/2-76-077A | Andersen and UW Mark III Impactors | Nonclassified Boiler | Fabric Filter | 39 |
| 75 | Bradway, R. M. et al., EPA-600/2-76-077A | Andersen and UW Mark III Impactors, Rich 100-CNC | Nonclassified Boiler | Fabric Filter | 82 |
| 76 | Cass, R. W., and I. E. Langley, EPA-600/7-77-023 | UW Mark III and Andersen Impactors, Rich 100-CNC, Bausch and Lomb Model 40-1-OPC 1604 | Electric Arc Furnace | Fabric Filter | 332 |
| 77 | Rei, M. T., and D. W. Cooper, EPA-600/2-76-202 | Andersen Impactor, Bausch and Lomb Model 401-1-OPC, Rich 100-CNC | Laboratory Analysis | Wet Scrubber | 52 |
| 78 | Dennis, R. et al., EPA-650/2-74-036 | Andersen Impactor | Prototype Test | Novel | 32 |
| 79 | Werner, A. S. et al., EPA-600/7-76-017 | UW Mark III Impactor | Residual-Oil Boiler | Cyclone | 2 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 80 | Nichols et al., "Collection Efficiency on Three ESP," EPA-600/2-75-056, October 1975 | Brink BSM-11 Impactor, Modified, Other-CCNC, Andersen Impactor, ROYCO Model OPC | Rotary Kiln in Cement Manufacture | ESP | 22 |
| 81 | Gooch, J. P. et al., SORI-EAS-76-471, Draft, September 1976 | Brink Impactor, Whitby Electrical Analyzer 3030, Andersen Impactor | Coal-Fired Boiler | ESP | 42 |
| 82 | Nichols, G. B. et al., SORI-EAS-76-511 | Modified Brink Impactor | Copper Smelter | ESP | 8 |
| 83 | Gooch, J. P. et al., EPA-600/2-76-141 | Brink BMS-11 Impactor, Whitby Electrical Analyzer Model 3030 | Sulfate Pulping | ESP | 23 |
| 84 | Gooch, J. P. et al., EPA-600/2-76-141 | Brink and UW Mark II | Sulfate Pulping | ESP | 13 |
| 85 | Nichols, G. B., and J. D. McCain, EPA-600/2-75-056 | Brink and Andersen Impactors | Unclassified Boiler | ESP | 12 |
| 86 | McCain, J. D., "Evaluation of Rexnorp Gravel Bed Filter," EPA-600/2-76-164 | Andersen Impactor, Other-CNC | Clinker Cooler in Cement Manufacture | Novel | 49 |
| 87 | Harrisburg Municipal Incinerator | Brink and Andersen Impactors | Solid Waste Incinerator | ESP | 10 |
| 88 | McCain, J. D., SORI-EAS-73-052 | Other | Ceramic/Clay Dryer | Cyclone | 6 |
| 89 | Gooch, J. P., and G. B. Nichols, SORI-EAS-77-098<br><br>EPRI-RP4-1 | Modified Brink Impactor, Andersen Impactor, Whitby Electrical Analyzer Model 3030 | Coal-Fired Boiler | ESP | 33 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 90 | EPA Contract No. 68-02-1869 | UW Mark III Impactor | NA | Wet Scrubber | 25 |
| 91 | EPA Contract No. 68-02-1869 | UW Mark III Impactor, Wire Screen Diff. Battery | NA | Wet Scrubber | 53 |
| 112 | Coal and Refuse Test, SORI-EAS-75-316 | Andersen and Other Impactor | Solid Wastes Coal-Fired Boiler | ESP | 52 |
| 113 | NA | Brink Impactor | Steel Foundry | NA | 7 |
| 114 | McCain, J. D., and W. B. Smith, Final Report, SORI-EAS-74-158 | Andersen Impactor | Unclassified Boiler | Cyclone | 7 |
| 115 | McCain, J. D. et al., SORI-EAS-74-418 and SORI-EAS-75-062 | Andersen and Other Impactors, Other-OPC | Coal-Fired Boiler | ESP | 69 |
| 116 | Bird, A. N., SORI-EAS-73-124 | Brink Impactor | Coal-Fired Boiler | Wet Scrubber | 12 |
| 117 | Bird, A. N., SORI-EAS-73-200 | Modified Brink Impactor, Climet-OPC, Other-CNC | Steel Foundry | NA | 8 |
| 118 | Nichols, G. B., SORI-EAS-74-009 | Brink and Andersen Impactors | Unclassified Boiler | ESP | 10 |
| 119 | Nichols, G. B., Company Correspondence, A1402-3005-IF | Brink Impactor | Unclassified Boiler | ESP | 6 |
| 120 | Nichols, G. B., and J. D. McCain, EPA-600/2-75-056 | Andersen and Other Impactors | Unclassified Boiler | ESP | 24 |
| 121 | Nichols, G. B., and J. P. Gooch, A1364-2975 | Brink Impactor | Unclassified Boiler | ESP | 10 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 123 | McCain, J. D., SORI-EAS-73-127 | Modified Brink Impactor | NA | Cyclone | 8 |
| 124 | McCain, J. D., SORI-EAS-73-127 | Modified Brink Impactor | NA | Cyclone | 6 |
| 127 | Dismukes, E., SORI-EAS-75-311, EPA-600/2-75-015 | Andersen Impactor, Other-CNC Impactor | Unclassifed Boiler | ESP | 15 |
| 128 | Dismukes, E., SORI-EAS-75-311, EPA-600/2-75-015 | Modified Brink and Andersen Impactors | Unclassified Boiler | ESP | 47 |
| 133 | McCain, J. D., SORI-EAS-76-355 (July 15, 1976) | Brink BMS-11 Impactor and Andersen Model III Impactor | Nonclassified Boiler | Hot side ESP | 18 |
| 137 | Bryant, M. A., United McGill Corp. Report (Dec 14, 1976) | Sierra C-226 Impactor | Wood-Fired Boiler | Mobile ESP | 7 |
| 142 | EPA Contract No. 68-01-3155 Task No. 1 (August 1976) | Andersen Model III Impactor | Primary Metals Process | Cyclone | 3 |
| 157 | EPA Contract No. 68-02-2144 Location 3 | Brink BMS-11 Impactor | Gas-Fired Kilns in Cement Manufacture (Dry) | Multiclone | 1 |
| 158 | EPA Contract No. 68-02-2144 Location 9 | Brink BMS-11 Impactor | Gas-Fired Kilns in Cement Manufacture (Wet) | Wet, Hot side Low Voltage ESP | 2 |
| 159 | EPA Contract No. 68-02-2144 Location 9 | SASS Train-with Cyclones | Gas-Fired Kilns in Cement Manufacture (Wet) | Wet, Hot side Low Voltage ESP | 3 |
| 160 | EPA Contract No. 68-02-2144 Location 10-1 | Brink BMS-11 Impactor | Wood-Fired Boiler | Multiclone Variable Throat Venturi Scrubber | 1 |
| 161 | EPA Contract No. 68-02-2144 Location 10-2 | SASS Train-with Cyclones | Nonclassified Boiler | Wet Hot side ESP | 4 |
| 162 | EPA Contract No. 68-02-2144 Location 12 | SASS Train | Petroleum Process Heater | None | 2 |
| 163 | EPA Contract No. 68-02-2144 Location 13 | SASS Train-with Cyclones Brink Model B Impactor | Wood-Fired Boiler | Multiclone | 3 |

| Test Series No. | Report's Author and Name | Testing Equipment | Source | Control Equipment | No. of Runs |
|---|---|---|---|---|---|
| 164 | EPA Contract No. 68-02-2144 Location 14 | SASS Train | Oxlance in Steel Production | Dry Coldside High Voltage ESP | 1 |
| 165 | EPA Contract No. 68-02-2144 | Andersen Model III Impactor SASS Train-with Cyclones | Internal Combustion with Diesel Fuel | None | 3 |
| 166 | EACCS (EPA 68-02-2197) | SASS Train-with Cyclones | Coal-Fired Boiler | Multiclone | 1 |
| 167 | EACCS (EPA 68-02-2197) | SASS Train-with Cyclones | Coal-Fired Boiler | Multiclone | 1 |
| 168 | EACCS (EPA 68-02-2197) | SASS Train-with Cyclones | Coal-Fired Boiler | Multiclone | 1 |
| 169 | EPA-600/7-78-164c, August 1978 | Other - OPC Other Impactor | Coal-Fired Boiler | Variable - Throat Venturi Scrubber | 2 |
| 170 | EPA-600/7-78-164c, August 1978 | Other - OPC Other Impactor | Residual Oil-Fired Boiler | Dual Throat Venturi Scrubber | 4 |
| 187 | Cavanagh, L. A., et al., Contract No. 37-28046 | SASS Train-with Cyclones | Residual Oil-Fired Boiler | None | 8 |
| 188 | Cavanagh, L. A., et al., Contract No. 37-28046 | SASS Train-with Cyclones | Residual Oil-Fired Boiler | None | 6 |